A Synopsis

On

"Design & Analysis of Resource Management System for improving low turnaround of Railway Assets in Delhi Division of Indian Railways"

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1. ABSTRACT:

Indian Railway provides one of the safest mode of travel & transport to bulk users. Maintaining a high level of traffic safety in the Railway System depends directly on the numerous factors such as proper upkeep of Railway Assets like Locomotives, Coaches, Wagon, Signaling systems, Overhead transmission lines & related equipments and technical & procedural knowledge of rules & regularizations and established practices for handling regular train operations including working in exceptional/unusual situations.

For any organization, systematic record keeping of vital information's is an essential activity for facilitating the management to take balanced & prompt decisions based on critical information.

Railways maintain a number of assets like Locomotives, Coaches, Wagons, Tracks, signaling systems, Overhead transmission lines & related equipment etc. in order to provide uninterrupted train services to passengers, bulk movement of goods which generates a huge amount of data related to various activities involved in safe & punctual running of trains.

Manual records of vital information related to maintenance of various assets leads to a relatively slower, inefficient and too hard to control. Many times, a situation requires accurate, timely and often immediate action to ensure smooth train operation. In such cases, manual record-keeping proves to be inadequate.

In order to cope with requirements of increased productivity in terms of running of rising numbers of Passenger/ Freight trains, minimum response time in case of technical failures and train working under exceptional circumstances etc., it is becoming need of the hour to switchover to system of maintaining records through a web-based application against conventional methods of record keeping.

2. INTRODUCTION:

Delhi Division of Northern Railway is one of the biggest & busiest divisions of Indian Railways serving States of Haryana, Punjab, Delhi and Uttar Pradesh.

The key statistics of the division are as under:

SN	Item	Values
1.	Total Route / Track Kms	1492 km/ 3266 km
2.	Total Section	1. DLI – Ghaziabad 2. Hazrat Nizamudin – Faridabad – Palwal 3. Delhi – Rewari 4. New Delhi – Panipat – Ambala 5. Delhi–Rohtak–Jind–Jakhal–Bhatinda 6. Delhi – Meerut – Saharanpur 7. Delhi – Shamli – Saharanpur 8. Narwana – Kurukshetra 9. Jind–Panipat 10. Jind-Sonipat 11. Rohtak - Panipat
3.	Total Trains handled per day	785
4.	Coaching Trains/ day	488 (Including 25 Pairs of Rajdhani Express/ 12 pairs of Shatabdi Express / 02 nos. of vande Bharat Express / 01 no. of Gatiman Express).
5.	Freight Trains/ day	300
6.	Total nos. of Stations	243
7.	Total Employees	35000 +
8.	Earning per day	26.64 Cr

IR uses numerous key IT applications for delivery of its core services to passengers and its stake holders like.

- **Passenger Reservation System & e-ticketing through IRCTC:** It has the capacity to book 15000 tickets per minute and can handle up to 3 Lakhs users concurrently approx. 16,46,000 tickets per day on IRCTC website).
- **Freight Operations Information Systems (FOIS):** About 12,500 rakes of Freight trains are monitored daily through this module over IR.
- **Control Office Application (COA) and Timetable Management System:** About 5, 00,000 arrival/departure events of 14000 trains are recorded each day in 77 control offices through COA over IR.

- **Crew Management System (CMS):** Approx. 47,000 Train crews are booked at 362 lobbies all over IR.
- **SaTSaNG – software aided train scheduling:** The Software Aided Train Scheduling and Network Governance (SATSaNG) project is building a tool for efficient allocations and robust time tables.

However, smaller maintenance units responsible for up-keep of all vital Railways assets (like Locomotives, Coaches, Wagons, Over Head transmission line, Signaling System, Railway Stations, Bridges and humans resource comprising of Locomotive Drivers Guards / TTEs/ station Managers etc.) mainly uses conventional methods of records – keeping which are **labour intensive, costly** and many a times, unable **to provide timely & adequate information** to the management so as to assist managers for taking appropriate & quick decisions.

With the increased in number of passenger & goods trains day by day, the volume of data is increasing by manifolds and therefore, conventional method of record – keeping is no longer effective.

In line with above requirements, it is felt necessary to have a robust IT application to cater requirements of various maintenance units which work round the clock to facilitate safe running of passenger/Freight trains.

The present study is intended for design, analysis & development of a suitable web-based Resource Management System which is capable for catering the following works:

A. Record–keeping & dissemination of vital informations related to maintenance of AC/Non –AC Coaches (Approx. 2500 nos) maintained at various coaching depots at New Delhi, Old Delhi, Nizamuddin, Anand Vihar, Meerut City, Rohtak, Jhind & Panipat over Delhi Division including their failure investigations & related activities.

B. Record-keeping & dissemination of vital informations related to Diesel Locomotive running Passenger/Freight trains including their failure investigations & related activities.

C. Record-keeping & dissemination of informations related to Pre-Departure detention (PDD) of Freight Trains at 19 train interchange points over Delhi Division and related analysis to reduce wastage of Train Running Staff (Loco Pilots/ Astt. Loco Pilots & Guards).

D. Record-keeping & dissemination of informations related to training of Running Staff (Loco Pilots/Astt. Loco Pilots) to facilitate advance planning of Training.

The intended application is expected to result in, increased efficiency in overall management of train operation in terms of faster turnaround of Railway Assets, help management in taking prompt decisions, improved & timely analysis of failure of Assets and fixing-up responsibilities & accountabilities, adequate use of resources leading to overall improvement in services to public by way of safe & punctual running of trains.

Keywords- IR: Indian Railways, IRCTC: Indian Railway Catering & tourism corporation, FOIS: Freight Operations Information System, CMS: Crew Management System, PDD: Pre-Departure Detention.

3. Literature Review:

Several units of adjoining Railways were visited to study, if similar efforts have been done in recent past. After visiting numerous units, it was found that most of the units are still using conventional methods of record-keeping by deploying lots of human resource. Most of the units were found using MS Excel/Ms Word along with conventional methods for documentations of information but these are considered inadequate with respect to requirements of the Organization.

The train control office which acts as common data center to all such maintenance units has provided some standard data formats for collection of data for various periods and for various activities in Excel formats through emails. Collected data are used by these control centers to take short term decisions in train operations and for dissemination of information to higher authorities for taking long term policy decisions.

4. Gaps in Research:

Quite often critical data are expected from maintenance units for taking short/ long term policy decision by higher management. In such cases, many units are either unable to provide requisite information or provide incomplete information leading to decision based on incomplete information. Such decisions may have severe financial implications on the organization.

These control centers responsible for taking quick decisions are not having real-time information of such critical information which has implications on punctual running of trains. They have to depend upon various smaller units for information to take quick action which takes significant time resulting in loss of time/delay in service. Similarly, higher authorities in absence of critical information are bound to take long form decisions based on available information.

5. Research Questions:

Aim 1: Will the development of a standardized, web-based application provide decision support tools for train Running control Centre's?

Aim 2: Will the application increase the efficiency of organization in terms of higher productivity, higher turnaround of Rolling Stock and overall improvement in safe & punctual running of trains?

Aim 3: Will there be any tangible benefits in terms of financial savings?

6. Research Objective

The main objective of the research is to create a robust Resource Management System that includes global access, standardization and knowledge based tools with an efficient interface to ensure quick decision process.

After extensive survey of similar units of Railways & discussion with maintenance engineers, experienced train controllers & other stakeholders, following objectives have been identified which is targeted for redressal with the development of intended application.

A. To optimize availability of critical information related to Coach Maintenance resulting in increased availability of Coaches by facilitating in providing real-time information about:

i. the details of major sub-assemblies/ passenger amenities (with details of make) fitted on every coach.
ii. the details of availability of fit coaches for each maintenance unit.
iii. the details of each defective coach under maintenance units and reason thereof.
iv. the details of failure of coaches & its investigation for fixing accountabilities.

B. To optimize availability of critical information related to Locomotive Operations resulting in increased availability of Locomotives by facilitating in providing real time information about:

i. the details of all the locomotives running on each train alongwith all relevant parameters of the locomotive over the Delhi Division Territory.
ii. the details of all the Locomotives which are out of service due to some major defects.
iii. the details of all the Locomotives which are running over due stipulated maintenance.

iv. the details of failure of locomotives and its investigation for fixing accountabilities

C. **To optimize availability of critical information related to Pre-Departure Detention (PDD) of train resulting in increased availability of locomotive drivers by facilitating in providing real time information about:**

i. the number of freight trains waiting at various interchanged points for path and reasons thereof.
ii. the total wastage of man-hours due to either bad planning or unforeseen circumstances.

D. To optimize availability of critical information related to training of Running staff resulting in increased availability of Loco Pilots /Astt. Loco Pilots by facilitating in providing real time information about:

i. the details of various types of mandatory/refresher training in respect of each running staff as train cannot be made to run with staff having training overdue.
ii. the details of training arising for running staff for advance planning so that it does not have adverse effect on train operation.

7. Methods- Designing the Solution

The application is proposed to be developed using Laravel 9 (a PHP framework), MySQL & Other related technologies. There are several advantages and benefits of using a web framework in general and Laravel in particular. According to a survey made by interview. Com, Laravel is the most popular PHP framework in 2022 [1].

Laravel is a PHP framework for web artisans, a web application framework with expressive, elegant syntax. It is open –source with an MVC design. It needs the least configuration with an impressive syntax and is well known for its simplistic and fast coding style. It reuses current components of various frameworks for creating a web application. Since it is simple to use, it lessens the development time framework. It has a modular packaging system and a dependency manager for Laravel. It is apt for all kinds of enterprises because of its salient features, reliable performance, authentication sessions, and flexibility [2].

The advantages of using Laravel Framework are detailed as under [3]:

A). Blade Template Engine

Laravel comes equipped with the Blade template engine, which is simple but very powerful, compared to the PHP templating engine. Along with some convenient

shortcuts for general PHP functions, it also provides features like template inheritance and displaying data that add flexibility to the web development process.

b). Eloquent ORM

Eloquent ORM in Laravel provides web developers with a simple Active Record implementation that makes their interaction with databases easy and less time-consuming. It lets them write databases queries using PHP syntax, and they don't need to write or know SQL for updating or modifying databases.

c). Laravel MVC Architecture

Laravel is an MVC-based PHP framework that ensures a tight separation between presentation layers and business logic. MVC stands for Model, View, and Controller. It is a design pattern that separates the model (logic, data handling), View (UI), and controller processes (interface). Being bases on MVC, the Laravel framework provides many features like high performance, increased security, and scalability.

d). Open Source and Wide Community

Laravel is an open-source framework for web developers. Also, it has powerful community that supports the framework to make it more advance and flexible.

e). Object-Oriented Libraries

Laravel PHP framework is packed with many built-in object-oriented libraries that are full of amazing features for developers. Along with these fantastic Laravel framework features, various reasons make organizations ready to go ahead with Laravel development services.

f). Security

Laravel supports several features to prevent basic security vulnerabilities such as SQL injection, cross-site request forgery (CSRF) and cross-site scripting (XSS).

8. Future Scope

Based on the various discussions with stakeholders, it is quite likely that the current IT application shall facilitate in taking decisions very confidently for smooth train operation. Therefore, an integrated application for Indian Railways can be got developed so as to get optimum benefits over IR. Since, the current applications are limited to management of only few assists, similar IT application for management of maintenance of Bridges, Over-head transmission lines, Electric Sub-station, Freight Depots, and Fuel Inventory Management System etc. can be developed for overall improvement in Railways.

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